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Errata Sheet

No. 1

ENGINEERING AND DESIGN

Periodic Safety Inspection and Continuing
Evaluation of USACE Bridges

ER 1110-2-111

30 April 1997

1) Page 1. Replace reference g with the following:
"Culvert Inspection *Manual,"* Report No. FHWA-IP-86-2, July 1986, supplement to Reference 3d.

2) Page **3.** Replace first line of paragraph 8b(1) with the following:
(1) Reviewing and monitoring the data collection,

DEPARTMENT OF THE ARMY
U.S. Army Corps of Engineers
Washington, DC 20314-1000

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Regulation
No. 1110-2-111

30 April 1997

Engineering and Design
PERIODIC SAFETY INSPECTION AND CONTINUING EVALUATION OF USACE BRIDGES

1. Purpose

This regulation defines the policy and prescribes procedures and responsibilities for the periodic inspection and evaluation of bridges owned or maintained by the U.S. Army Corps of Engineers (USACE) on civil works projects.

2. Applicability

This regulation applies to all USACE Commands having civil works responsibilities.

3. References

a. 23 F.R. 650, National Bridge Inspection Standards, dated October 1988 (see Appendix A of this ER).

b. ER 1110-2-101, Reporting of Evidence of Distress of Civil Works Structures.

c. EM 1110-2-2002, Evaluation and Repair of Concrete Structures.

d. "*Bridge Inspector's Training Manual/90*," July 1991 (Revised March 1995), Federal Highway Administration, 6300 Georgetown Pike, McLean, VA, 22101.

e. "*Bridge Inspector's Manual for Movable Bridges*," Report No. FHWA-IP-77-10, 1977, supplement to Reference 3*d*.

This regulation supersedes ER 1110-2-111, dated 31 December 1992.

f. "*Construction and Maintenance Section*," American Railway Engineering Association, Volumes I & II.

g. "*Culvert Inspection Manual*," Report No. FHWA-IP-86-2, July 1986, supplement to Reference 3*d*.

h. "*Inspection of Fracture Critical Bridge Members*," Report No. FHWA-DP-80-1, September 1980, supplement to Reference 3*d*.

i. "*Manual for Maintenance Inspection of Bridges*," American Association of State Highway and Transportation Officials, 444 North Capitol Street, Washington, DC, 20001 (latest edition).

j. "*Manual for Railway Engineering*," American Railway Engineering Association, Volumes I & II (latest edition).

k. "*Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges*," Design and Inspection Branch, Bridge Division, Federal Highway Administration, Washington, DC (latest edition).

l. "*Standard Specifications for Highway Bridges*," American Association of State Highway and Transportation Officials, 1992.

m. "*Underwater Inspection of Bridges*," Report No. FHWA-DP-80-1, Final Report, November 1989.

n. "*USACE Bridge Inventory System*," September 1992.

o. "*Evaluating Scour at Bridges*," Hydraulic Engineering Circular (HEC) 18, Federal Highway

Administration, Report No. FHWA-IP-90-017, November 1995.

p. "*Stream Stability at Highway Structures*," Hydraulic Engineering Circular (HEC) 20, Federal Highway Administration, Report No. FHWA-IP-90-014, November 1995.

q. "*Manual for Condition Evaluation of Bridges*," American Association of State Highway and Transportation Officials, 444 North Capitol Street, Washington, DC 20001, 1994.

r. "*Seismic Retrofitting Manual for Highway Bridges,*" FHWA-RD-94-052, May 1995.

4. Background

The Surface Transportation Assistance Act of 1978 (PL 100-17) requires that all structures defined as bridges (see reference 3*a*) on public roads be inventoried and inspected in accordance with the National Bridge Inspection Standards (NBIS). Under the standards, each state is required to record and maintain structure inventory and appraisal data on each bridge and submit the data to the Federal Highway Administration upon request.

5. Policy

All bridges (see part 650.301 of reference 3*a* for definition) owned or maintained by USACE on civil works projects shall be inspected and inventoried to ensure their safety and structural integrity.

a. Public highway bridges with spans greater than 6.1 m (20 ft) shall be inspected and evaluated in compliance with the NBIS.

b. Railway bridges shall be inspected and evaluated in accordance with references 3*d* through 3*j*, and 3*m*.

c. Access bridges to outlet works, or dam service bridges which are closed to the public, foot/pedestrian bridges, and all bridges on public roads with spans of 6.1 m (20 ft) or less shall be inspected and evaluated in accordance with a comprehensive, uniform plan approved by each Major Subordinate Command (MSC) in consultation with HQUSACE (CECW-ED).

d. An inventory of subject bridges (public highway, railroad, foot/pedestrian, access bridges to outlet works and dam service bridges) shall be prepared and maintained in accordance with the Corps of Engineers USACE Bridge Inventory System (CEBIS), reference 3*n*, except pedestrian walkways or passageways which provide internal access in civil works structures. The CEBIS is composed of three database files: the Structure Inventory and Appraisal (SI&A), the Inspection Sheet, and the Maintenance Sheet.

e. All existing bridges over tidal and nontidal waterways should be evaluated for the risk of failure from scour during the occurrence of a flood on the order of magnitude of the 500-year return period. Bridge scour evaluations shall be conducted for each bridge to determine whether it is scour critical in accordance with references 3*o* and 3*p*.

f. Fracture critical members (FCM) of any bridge shall be identified and recorded in the bridge inspection report and CEBIS. An inspection plan of FCM shall be developed and executed. See Appendix B for more guidance.

g. Bridge seismic evaluations and retrofitting requirements shall be conducted in accordance with sections 1.4 and 1.5 of reference 3*r*.

h. Seismic zones and soil types for each bridge shall be identified and recorded in the bridge inspection report and CEBIS.

i. HQUSACE (CECW-ED) shall send consolidated SI&A data of USACE public highway bridges to the Federal Highway Administration (FHWA) to comply with the NBIS.

6. Types of Safety Inspections

Inspection during the service life of the bridge includes an initial inventory inspection after construction is complete, periodic routine inspections, special inspection to evaluate damage or deterioration, or to monitor performance, and underwater inspections which require special equipment for access. Types of inspections are described in Appendix C.

7. Frequency of Inspections

A routine inspection shall be conducted every two years unless the condition of the bridge indicates that more frequent inspections are required. Other types of inspection and their frequencies will depend upon the age, present load capacity, traffic, type of construction, state of maintenance, and any known deficiencies related to fatigue, scour, seismic influences, fracture of critical members, and corrosion. Evaluation of bridge condition shall be the responsibility of the structural engineer in charge of the inspection program. The maximum inspection interval may be increased for bridges if past inspection reports and favorable experience and analysis justify it. Maximum inspection intervals of four years and five years between inspections are permitted for the bridges described in paragraphs 5*a* and 5*c*, respectively. Proposals to inspect bridges at intervals greater than two years shall be submitted for approval with supporting data through the MSC to CECW-ED for the bridges described in paragraph 5*a*, and to the MSC for the bridges described in paragraph 5*c*. The plan for inspecting any bridge at intervals greater than two years should be based on the type and frequency of vehicular traffic (i.e., with tires, treads, or on a track) which may cause fatigue or deterioration of the structural members. Actual inspections or reports should be performed in the most cost-effective manner. Special inspections are necessary after bridges experience significant events such as hurricanes, earthquakes, fires, floods, or collisions. Underwater bridge members shall be inspected to the extent necessary to determine the condition and structural integrity of the bridge. An underwater inspection of all substructures shall be performed at an interval not to exceed five years.

8. Organizational Responsibilities

HQUSACE, MSC, and District responsibilities require teamwork between engineering and operations divisions at all levels, and with the U.S. Army Engineer Waterways Experiment Station (WES). The responsibilities are described below.

a. *District*. The engineering divisions shall be responsible for the following activities:

(1) Formulating the inspection plans, conducting the inspections, processing and analyzing the results of the instrument observations, evaluating the condition of the bridges, determining scope and frequency of future inspections, and preparing and submitting the periodic inspections reports.

(2) All inspection reports shall be certified by the district and submitted by the District Commander to the MSC Commander (or to the delegated approval authority) for certification of quality assurance and approval (Part 2 of Appendix D) within 60 days after the inspection.

(3) Preparing, maintaining, and updating the District CEBIS.

(4) Inviting a representative from the operations division to participate in each inspection. For those bridges being inspected for the first time, a representative from the construction division shall be invited to participate.

(5) Coordinating with operations division on the annual Operations and Maintenance (O&M) budget process for funding existing bridge inspections, evaluations, repairs, improvements, or rehabilitation related to bridge safety.

(6) Notifying any city, county, state, or local government and operating railway company which has jurisdiction of the road of the inspection.

b. *MSC*. The engineering directorates shall be responsible for the following activities:

(1) Reviewing and monitoring the data collection, processing, evaluation, and inspection activity; maintaining the schedule of inspections and status of reports; and establishing procedures to promptly inform CECW-ED and CECW-OM when the evaluation of a bridge or instrumentation data indicate that a bridge is unsafe.

(2) Coordinating with operations division on the annual O&M budget process for funding existing bridge inspections, evaluations, repairs, improvements, or rehabilitation related to bridge safety.

(3) MSC Commanders are authorized to approve inspection reports, except as specifically stated below. Districts and operating MSCs shall perform an independent technical review. If the MSC decides to delegate approval authority to the districts, then it should retain responsibility for program management and oversight. Review and approval of reports should be completed within 120 days after completion of the field inspection. This period should include satisfactory resolution of all

review comments. Reports shall be sent to CECW-ED for review and approval, with the views and recommendations of the MSC Commander included in the transmittal correspondence only under the following circumstances:

(a) Views and recommendations are requested by HQ representative at the inspection.

(b) Bridge inspection indicates that the safety of a bridge is in jeopardy and requires posting, as described in paragraph 10*i*.

(4) An information copy of each approved report shall be furnished to CECW-ED, including submittal and approval correspondence.

(5) The MSC Commander shall consolidate District CEBIS into MSC CEBIS and submit to CEWES-ID before 1 February of each calendar year.

(6) MSC Commander shall maintain and update the MSC CEBIS.

(7) A qualified structural engineer, responsible for the bridge inspection safety program at the MSC/ district, should be designated as the point of contact for CEBIS, inspection, report, maintenance, repair, and rehabilitation of bridges.

(8) MSC is responsible for development of a Quality Assurance Program and for completion of Part 2 of Appendix D.

c. HQUSACE. CECW-ED shall be responsible for the following activities:

(1) Overseeing engineering management of all phases of the USACE Bridge Safety Program.

(2) Coordinating with CECW-OM on the annual O&M budget process for funding existing bridge inspections, evaluations, repairs, improvements, or rehabilitation related to bridge safety.

(3) Developing engineering guidance for implementing a Bridge Safety Program covering public access bridges and other USACE bridges.

(4) Providing policy advice to HQUSACE elements on any new legislation related to the safety of USACE bridges.

(5) Providing policy compliance review of all decision documents related to bridge safety deficiencies.

(6) Acting as proponent for training needs of USACE bridge engineers and coordinating the training effort with courses offered by FHWA and American Association of State Highway and Transportation Officials (AASHTO).

(7) Acting as liaison with state and other Federal agencies to evaluate procedures and capabilities with respect to bridge safety.

d. Waterways Experiment Station. The WES Information Technology Laboratory shall be responsible for the following activities:

(1) Developing a Bridge Management System (BMS) that uses database diskettes furnished to MSCs and districts upon request.

(2) Consolidating and compiling the data from all district inspection reports and MSC CEBIS into the computer database, compiling SI&A data of USACE public highway bridges, and submitting to CECW-ED for reporting to FHWA before 15 March of each calendar year.

(3) Providing CEBIS report to HQUSACE, MSCs, districts, and other USACE installations upon request.

9. Qualifications of Bridge Inspector's Team

a. Structural engineer. The structural engineer in charge of the bridge inspection and evaluation program shall be a registered professional engineer and shall meet the minimum qualifications stated in paragraph 650.307 of reference 3*a* and have completed a comprehensive training course based on the current version of reference 3*d*.

b. Field inspection team. All field inspections shall be performed by a team consisting of a team leader and at least one bridge technical specialist.

(1) The team leader shall be a structural engineer (registered professional engineer) who meets the minimum qualifications stated in paragraph 650.307 of reference 3*a* and have completed a comprehensive training course based on the current version of reference 3*d*.

(2) Bridge technical specialists shall meet the following minimum qualifications:

(a) Have a Bachelor of Science Degree in Civil Engineering, or

(b) Have an Associate Degree in Civil Engineering Technology, and have completed a comprehensive training course in *"Engineering Concepts for Bridge Inspectors"* based on the current version of reference 3*d*.

(3) The mechanical and electrical engineers involved with the inspection of movable bridges (swing, bascule, and vertical lift bridges) shall be registered professional engineers who are proficient with the methods and procedures described in Chapter 20, reference 3*d*.

c. Underwater inspections and scour evaluation. Underwater inspectors must have knowledge and experience in bridge inspection. A diver not fully qualified as a bridge inspector or bridge inspection team leader must be used only under close supervision. Hydraulic and geotechnical engineers involved with the bridge scour evaluation should be registered professional engineers who are proficient in the methods described in references 3*o* and 3*p* or have successfully completed the FHWA's training course, "Stream Stability and Scour at Highway Bridges." All underwater inspections and scour evaluations shall be conducted under the direct supervision of a qualified bridge inspection team leader.

d. Independent technical review. Reviewers shall be senior engineers who have the proper knowledge, skills, training, and experience; and who were not directly involved in the inspection or report preparation. The reviewers' qualifications shall not be less than those stated in paragraph 9*a*, and they must have current experience in inspecting and evaluating several bridges. Names and qualifications of the reviewers should be included in the district's quality control (QC) plans, and be approved by the MSC as part of its quality assurance (QA) program.

10. Inspection Procedures

A 5-year bridge inspection program budget and schedule shall be developed. Condition, age, size, and traffic are some of the parameters to consider in establishing priorities for the inspection plan. A copy of this plan is to be furnished through the MSC to CECW-ED by 15 February of each year.

a. Notification of inspections. CECW-ED shall be notified, through the MSC, at least 30 days in advance of a scheduled inspection in order to determine whether an HQ representative(s) will participate in the inspection.

b. Procedures for underwater and fracture-critical members. See Chapters 17 and 18 of reference 3*d* for details.

c. Procedures for inspection and evaluation of structure. See Chapters 7-14 of reference 3*d* for details.

d. Procedures for inspection of movable bridges. See Chapter 20 of references 3*d* and 3*e* for details.

e. Inspection of segmental concrete bridges, cable-stayed bridges, and suspension bridges. See Chapter 21 of reference 3*d* for details.

f. Procedures for evaluating scour at bridges. See references 3*o* and 3*p* for details.

g. Highway bridge load capacity rating. Each USACE bridge that is subject to NBIS inspection provisions shall be rated for safe load-carrying capacity. The capacity of all highway bridges shall be rated at two levels. The upper load level is referred to as the operating rating, and the lower load level is referred to as the inventory rating. Load ratings for bridge members shall be made in accordance with references 3*i* or 3*q*.

(1) A load capacity rating shall be performed as part of:

(a) The initial inventory inspection.

(b) Periodic routine inspections if rating is not available in records.

(c) Special inspection after bridges experience significant events such as hurricanes, earthquakes, fires, floods, or collisions.

(2) A load rating shall be performed whenever the dead load from the bridge surface has increased due to a major rehabilitation or replacement of the decking.

(3) All load ratings shall be based on both the AASHTO "HS" and "H" analysis vehicle configurations. Both the AASHTO "HS" and "H" truck load and lane loads shall be used to determine the rating values.

(4) If the inventory rating as defined by the AASHTO manual based on the "HS" vehicle loading equals or exceeds HS-20 33 tonnes (36 tons), it is not necessary to compute ratings based on the "H" loading.

h. Railway bridge rating. Evaluation of load capacity for railway bridges shall be determined in accordance with reference 3*j*.

i. Highway bridge posting. Posting a bridge for load-carrying capacity is required when the maximum legal load exceeds the operating rating capacity. Districts may choose to post an inventory rating capacity. If the bridge condition requires reducing the posted limit to less than 2.7 tonnes (3 tons), the bridge shall be closed for vehicular traffic.

11. Inventory and Inspection Report

a. Report preparation. A formal technical report shall be a permanent record and will serve as a basis for determining the need for remedial work. The report will be based on a detailed inspection and evaluation of each bridge as to its safety and structural adequacy. As a minimum, the report shall contain the results of the inspection and recommendations for remedial work, approximate total cost, and a scheduled completion date of any remedial work. In order to more accurately portray conditions and changes in conditions of surfaces and structural details, photographs are generally required. Photographs shall be provided of all areas requiring visual monitoring or critical regions of structural distress. The CEBIS printout shall be part of the inspection report. Report contents and format shall be as shown in Appendix E.

b. Report review and certification. All bridge inspection and evaluation reports shall receive an independent technical review. The district or operating MSC shall certify that the inspection and evaluation were performed in accordance with this regulation and the referenced criteria by qualified engineers, and that all remedial work necessary to assure that the safety of the bridge is not jeopardized is being developed on an appropriate schedule. See Appendix D for certification and approval.

c. Report distribution. One copy of each approved report shall be submitted by the originating office through the MSC to CECW-ED. An additional copy of each approved report shall be submitted by the originating office to CEWES-ID.

d. Inventory preparation. Each district shall prepare and maintain a District CEBIS of all its bridges. The District CEBIS includes the SI&A data shown in Appendices F and G. Newly completed structures, physical changes to existing structures which would alter previously recorded data, and placement of load and/or speed restriction signs shall be entered in the District CEBIS within 60 days after the change in condition. The MSC shall update and forward the MSC CEBIS data to CECW-ED and also furnish a copy to CEWES-ID within 30 days after receiving district updates.

e. CEBIS distribution. The District Commander shall submit one copy (diskette) of the District CEBIS to the MSC. The MSC shall consolidate all District CEBIS into MSC CEBIS and forward one copy to CEWES-ID. CEWES-ID shall consolidate all MSC CEBIS into civil works CEBIS and forward to CECW-ED.

12. Reporting Distress

If the bridge inspection and evaluation indicate evidence of distress or potential failure requiring immediate remedial action, the district shall inform CECW-E and CECW-O immediately through the MSC office. Emergency situations will be handled in accordance with the guidance set forth in reference 3*b*.

13. Interagency Coordination

In those cases where ownership of major elements is divided between the Corps and other agencies, information pertinent to the condition of project elements owned by others, as observed by the Corps inspection team, shall be furnished to the co-owner for information purposes only.

14. Funding

Requests for funding of bridge inspections, maintenance, and repair shall be prioritized and submitted to CECW-OM as part of the annual O&M budget process.

FOR THE COMMANDER:

OTIS WILLIAMS
Colonel, Corps of Engineers
Chief of Staff

7 Appendices
APP A - National Bridge Inspection Standard
APP B - Fracture Critical Members (FCM)
APP C - Description of Inspection Types
APP D - Statement of Inspection Review and Approval
APP E - Inspection Report Format and Content
APP F - Highway Bridge SI&A Sheet
APP G - Railway Bridge SI&A Sheet